## Space Weather Technical Forecast

Issued on Tuesday 3 December 2024 at 12:20 Local

**This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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**Space Weather Forecast Headline: Chance of isolated M-class flares.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar activity has been Low over the past 24 hours, peaking with a C6.1 flare observed at 03/0544 UTC from the vicinity of AR3905/06 in the southwest.

There are currently six numbered and two un-numbered sunspot regions on the visible disc, however these are generally simple with their magnetic configurations. The largest regions are AR3905 and AR3906 in the southwest disc, both moderate size bipolar regions and now approaching the southwest limb, with little overall change in development in recent imagery. AR3912 is also a moderate size bipolar region in the southeast disc, again with little overall change in development in recent imagery. Similar comments apply to AR3910 in the northwest. Other regions on the disc are smaller and magnetically simple. The new and currently unnumbered region rotating onto the southeast limb is difficult to fully assess at present due to the view angle.

A couple of filament eruptions off the southwest quadrant, near the vicinity of AR3905 and AR3906 are still being assessed for any potential Earth-directed component, however they look narrow and westerly directed. No other Earth-directed CMEs were observed in available imagery.

**Solar Wind / Geomagnetic Activity:** Solar winds speeds, measured by ACE/DSCOVR at L1, have ranged between background to slightly elevated, 350-460km/s. Density was mostly below average, but with occasional peaks into moderate levels The Interplanetary Magnetic Field (IMF) strength, Bt, was predominantly moderate, with occasional peaks around 14nT, due to the passage of 27 Nov CME. The north-south component (Bz) was mostly positive (northward) until the arrival of the CME (around 12/2000 UTC), re-orientating to mostly negative (southward) and peaking at -13nT. The Phi angle was positive (away from the Sun) for most of the period, but switched to negative (toward the Sun) after 03/1100 UTC. Geomagnetic activity was mainly Quiet (Kp 0-2), but with an Active interval 03/0000-0300 UTC.

**Energetic Particles / Solar Radiation:** High energy proton flux observed by GOES18 was at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was Background. The associated 24-hour fluence remained well below Active. The 03/0000 UTC observed was 1.12e6 total pfu.

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**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Mostly Low activity is expected with a chance of isolated M-class flares.

**Solar Wind / Geomagnetic Activity:** A slow CME from a filament eruption on 27 Nov arrived at Earth late on 02 Dec, however only limited enhancements are expected into day 1 (03 Dec). With no further enhancements from any CME arrivals or Coronal Holes, the solar wind speeds are expected to be slightly elevated to background throughout the period. Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals throughout. Any CME enhancement on Day 1 (03 Dec) brings a slight chance of an Active spell.

**Energetic Particles / Solar Radiation:** High energy protons are expected to persist at background with only a slight chance of responding as a result of any notable flare activity. High energy electron flux is expected to persist mainly at background with the associated 24 hour fluence remaining below the Active threshold.

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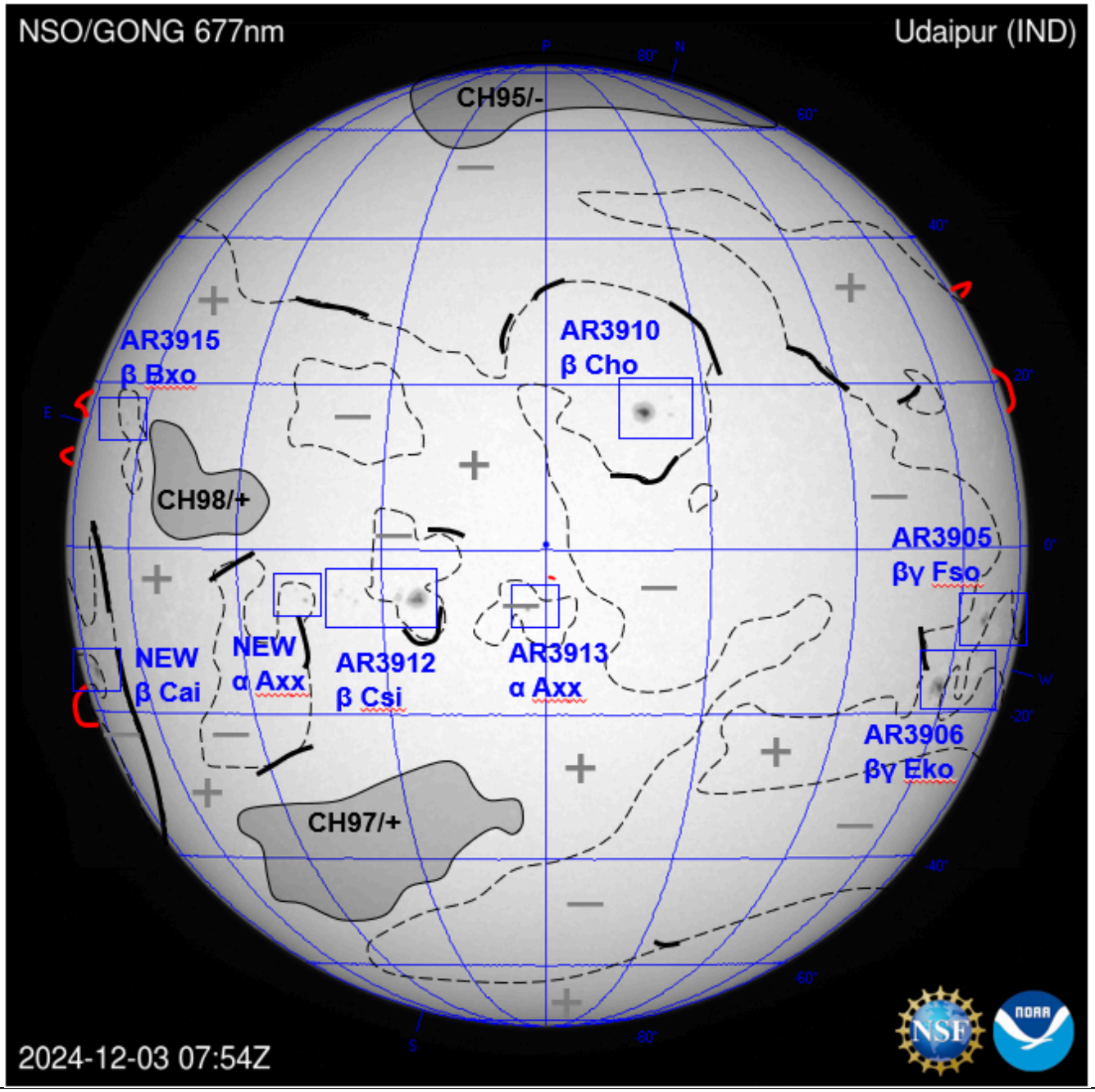
**Figure 1: Solar synoptic map - valid 03/0800 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms

A CME associated with a filament eruption off the southeast disc, which left the Sun on 27 Nov, arrived at Earth 02/2000 UTC, although any enhancements in geomagnetic activity are expected to be limited, perhaps giving Unsettled to Active intervals early on day 1 (03 Dec).

Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled intervals from day 2 (04 Dec).

Solar winds are expected to be slightly elevated at times, between 400-450km/s, during day 1 (03 Dec), before gradually declining to background levels from day 2 (04 Dec). Otherwise, in the absence of any other CME enhancements, generally slow-ambient solar wind speeds are expected the remainder of the forecast period with no significant Coronal Hole enhancement expected.

MOSWOC Enlil is currently providing reasonable support with slightly elevated winds at present, becoming slow through much of the forecast period. However, the enhancement to the solar wind speeds suggested into day 3 and 4 (05-06 Dec) are viewed with low confidence, as CH97 is considered too far south to connect significantly with Earth.

| Geomagnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 5 | 1 | 1 | 1 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

**Geomagnetic Activity - Earthbound Coronal Mass Ejections**

| Date/time 21.5R⊙ (UTC) | Halo: Full or Partial | Source | Source Location | Estimated Speed (km/s) | Estimated Arrival Time (UTC) | Comments |
|---|---|---|---|---|---|---|
| 28/11/2024 04:28 | Partial | Filament | SE | 390 | 02/12/2024 14:00 UTC | Moderate confidence of a glancing blow. Minimal enhancement expected. |

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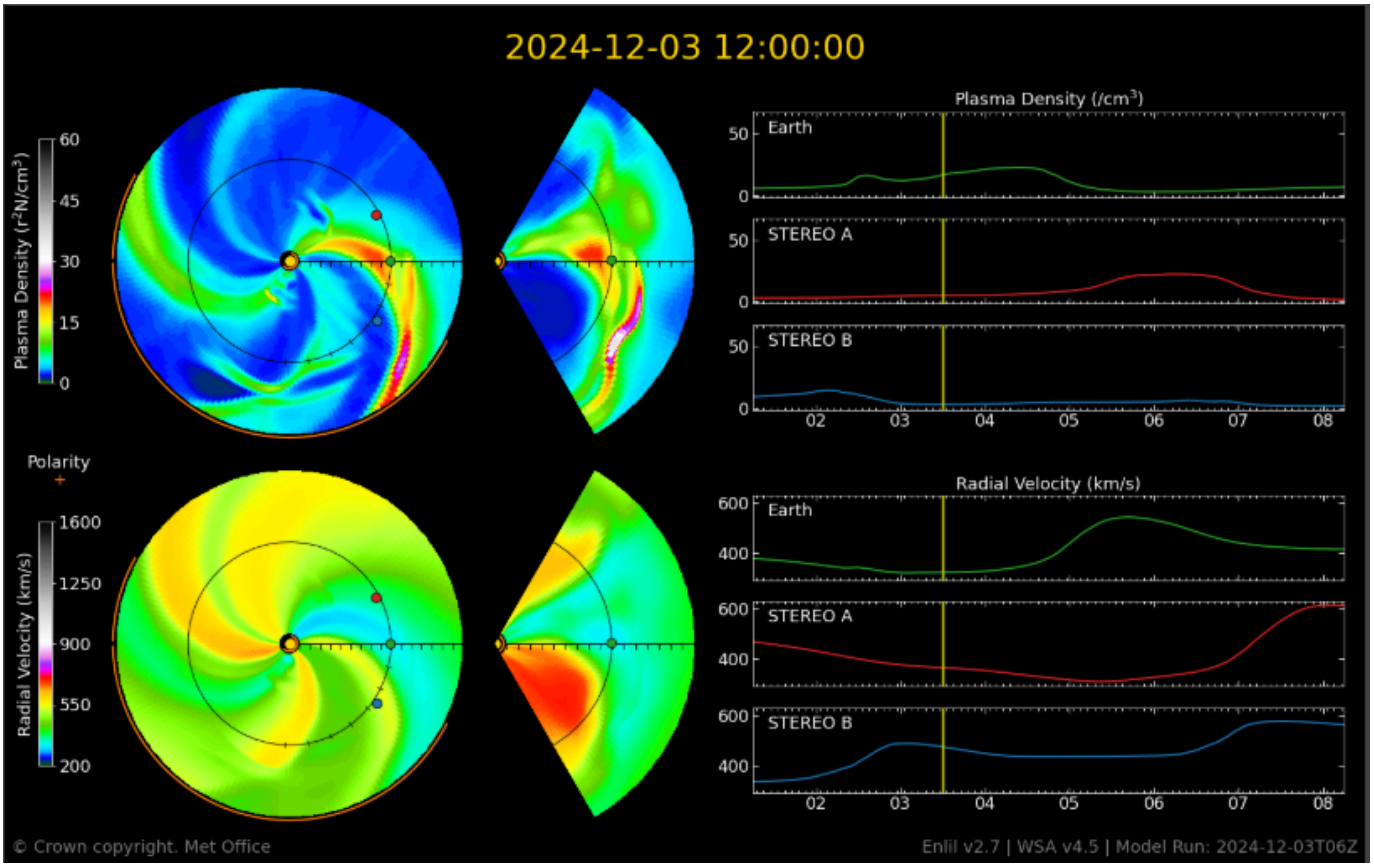
**Figure 2: MOSWOC Enlil**



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## Radio Blackouts - X-Ray Flares

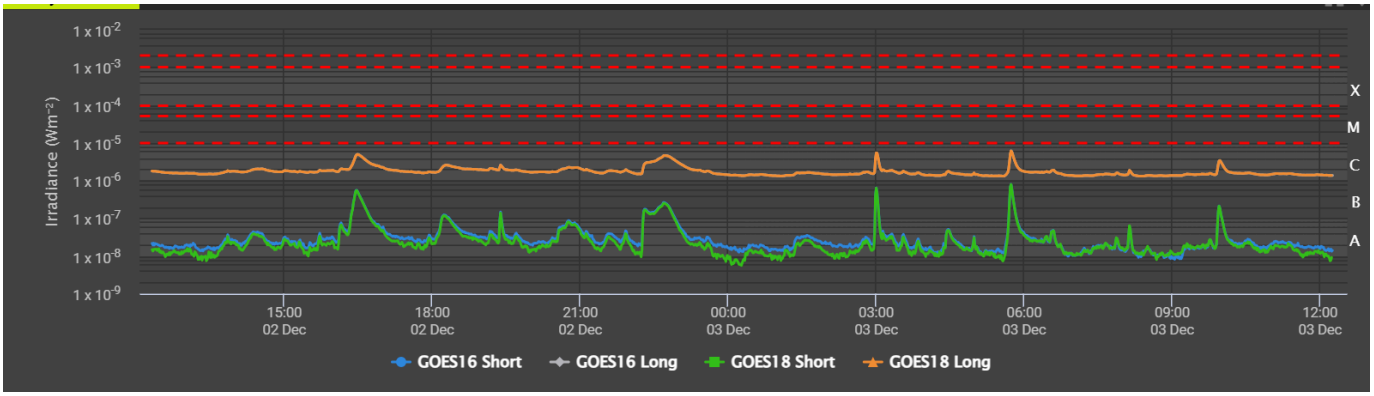
There are currently six numbered and two un-numbered sunspot regions on the visible disc, however these are generally simple with their magnetic configurations. The largest regions are AR3905 and AR3906 in the southwest disc, both moderate size bipolar regions and now approaching the southwest limb, with little overall change in development in recent imagery. AR3912 is also a moderate size bipolar region in the southeast disc, again with little overall change in development in recent imagery. Similar comments apply to AR3910 in the northwest. Other regions on the disc are smaller and magnetically simple. The new and currently unnumbered region rotating onto the southeast limb is difficult to fully assess at present due to the view angle.

Far-side data suggests a number of possible returning sunspots in the coming days, but this comes with some uncertainty until they rotate around the east limb. The other regions remain relatively stable and inactive. Mostly Low activity is forecast, with a chance of isolated M-class flares. Any increased chance of flares from potential oncoming regions is likely to be offset by AR3905/3906 rotating off the visible disc.

Note, assessment of sunspot regions is currently more challenging than usual due to the prolonged outage of available SDO HMI/AIA data with a corresponding lower confidence in flare risk.

| X-Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 (M Class) | No | 45 | 45 | 45 | 45 |
| Very Active | R3-R5 (X Class) | No | 5 | 5 | 5 | 5 |

**Figure 3: GOES16-18 X-Ray Flux trace.**

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## Solar Radiation Storms (High Energy Protons)

GOES-18 Proton flux is currently at background. While there are a couple of moderately sized regions on the better connected western disc, these are relatively simple and have remained largely inactive. Along with the other regions on the disc also being relatively small and simple, this only gives a slight chance of high energy proton enhancement through this period.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}sr^{-1}s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 10 | 10 | 10 | 10 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

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## High Energy Electrons (≥ 2MeV)

High energy Electron flux observed by GOES-16 is at Background. This is expected to persist, with no significant coronal hole or CME enhancements currently anticipated during the forecast period.

The associated 24 hr fluence is expected to persist below Active levels, with MOSWOC REFM currently considered to be providing good guidance.

| GEO Electron Environment | Level ($cm^{-2}sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ 2 MeV ≥ $1\times10^{8}$ | No | 1 | 1 | 1 | 1 |
| Very Active | ≥ 2 MeV ≥ $1\times10^{9}$ | No | 1 | 1 | 1 | 1 |

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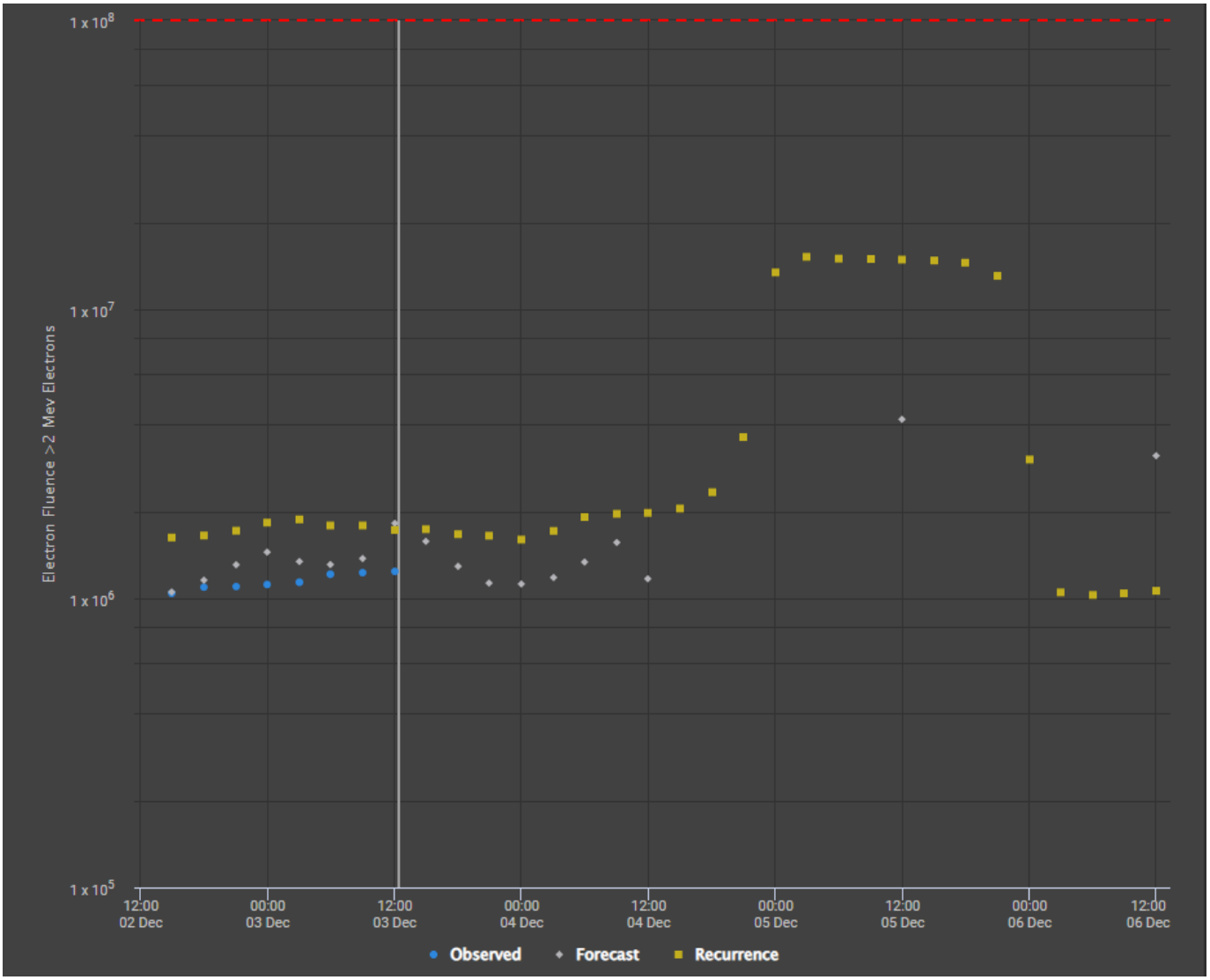
**Figure 4: Latest MOSWOC Enlil.**



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